Arnold Schwarzenegger
Governor

COLLABORATIVE NATIONAL PROGRAM FOR THE DEVELOPMENT AND PERFORMANCE TESTING OF DISTRIBUTED POWER TECHNOLOGIES

PIER FINAL PROJECT REPORT

Prepared For:
California Energy Commission
Public Interest Energy Research Program

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ASERTTI

ASERTTI Association of State Energy Research & Technology Transfer Institutions

May 2010
CEC-500-2010-017

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Acknowledgements

The authors would like to acknowledge the contributions of many who were involved in this collaborative effort. These people helped to make available a systematic means for collecting performance data on distributed generation/combined heat and power systems. That data is now available to users in California, the nation, and to the world community to help improve energy efficiency and reduce energy costs.

The Steering Committee (listed in **Figure 1**) provided critical guidance for the project and participated in monthly conference call meetings. James Foster of the New York State Energy Research and Development Authority provided technical guidance in many areas and was instrumental in connecting the large distributed generation/combined heat and power efforts in New York to this national effort by adopting these protocols for all of New York State Energy Research and Development Authority's efforts, including its database. Brian Gurney of Montana State University at Billings provided guidance on the process of including fuel cell distributed generation/combined heat and power systems into the final protocols and provided ongoing information on the performance of fuel cell systems being installed in projects he is managing. Paul Bergeron of the National Renewable Energy Laboratory has managed the national website, which is the national portal for those seeking information on this effort.

The members of the Stakeholder Advisory Committee listed in **Table 1** deserve recognition for volunteering many hours of time from their busy professional lives to review and provide guidance as well as comment on the protocols and the databases. A number of these individuals arranged for project team visits to their manufacturing facilities and installation sites. The subcontractors and Steering Committee members that provided important work products were the Gas Technology Institute, Southern Research Institute, Underwriters Laboratory, Connected Energy Corporation, University of Illinois – Chicago Energy Resources Center, Concurrent Technologies Corporation, and CDH Energy. Finally, the authors want to thank Sherry Benzmiller, project administrator of the Energy Center of Wisconsin, for her hours of effort in managing this project.

Please cite this report as follows:

Association of State Energy Research and Technology Transfer Institutions. 2010. *Collaborative National Program for the Development and Performance Testing of Distributed Power Technologies.* California Energy Commission, PIER Energy Systems Research Program. CEC-500-2010-017.

Preface

The California Energy Commission's Public Interest Energy Research (PIER) Program supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The PIER Program conducts public interest research, development, and demonstration (RD&D) projects to benefit California.

The PIER Program strives to conduct the most promising public interest energy research by partnering with RD&D entities, including individuals, businesses, utilities, and public or private research institutions.

- PIER funding efforts are focused on the following RD&D program areas:
- Buildings End-Use Energy Efficiency
- Energy Innovations Small Grants
- Energy-Related Environmental Research
- Energy Systems Integration
- Environmentally Preferred Advanced Generation
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Renewable Energy Technologies
- Transportation

Collaborative National Program for the Development and Performance Testing of Distributed Power Technologies is the final report for the Combined Heat and Power project, Contract Number 500-05-024 conducted by Association of State Energy Research and Technology Transfer Institutions. The information from this project contributes to PIER's Renewable Energy Technologies Program.

For more information about the PIER Program, please visit the Energy Commission's website at www.energy.ca.gov/research/ or contact the Energy Commission at 916-654-4878.

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Abstract

Distributed (on-site) generation technologies are emerging as a viable supplement to centralized power production. With their ability to deliver higher efficiency with combined heat and power, they are anticipated to be an important part of California's and the nation's strategy to improve energy efficiency and reduce environmental impacts, including global climate change. The *2007 Integrated Energy Policy Report* included a goal of achieving 4000 megawatts of new power generation through combined heat and power by the year 2020. The goal of this project is to increase in the adoption of distributed generation/combined heat and power units by providing performance data for technology comparisons of microturbine generators, reciprocating engine generator sets, small turbines, and fuel cell power systems. The project facilitated adoption by providing globally accessible information – via the internet – of combined heat and power systems. The collected data follows common protocols and hence provides a comparable platform. This data should encourage appropriate distributed generation/combined heat and power applications that provide real benefits to system owners. Performance information is provided by the development of four final protocols: a laboratory protocol, a field protocol, a long-term monitoring protocol, and a case study protocol. Their application with the resulting data is provided on two public searchable databases, which can be found at http://www.dgdata.org and http://chp.nyserda.org.

Keywords: Public Interest Energy Research Program, PIER, combined heat and power, CHP, Association of State Energy Research & Technology Transfer Institutions, ASERTTI, New York State Energy Research and Development Authority, NYSERDA, CHP database

Executive Summary

Introduction

Distributed generation technologies are emerging as a viable supplement to centralized power production. Distributed generation, also called on-site generation or decentralized energy, generates electricity from relatively small energy sources as supposed to a power plant. These technologies are able to deliver higher efficiency with combined heat and power (the application of an engine to generate both electricity as well as useful heat). These technologies are anticipated to be an important part of California's and the nation's strategy to improve energy efficiency and reduce energy-related environmental impacts, including global climate change.

This report describes the initial impetus for this work that emerged from discussions among the California Energy Commission, other Association of State Energy Research and Technology Transfer Institutions members, and the United States Department of Energy a decade ago. The focus of the report is on the work funded by the Energy Commission beginning in 2006. It describes the goal, objectives, and management structure of this collaborative effort.

Purpose

The goal of this project is to promote adoption of distributed generation and combined heat and power units by providing performance data comparisons for power generating systems. These include microturbine generators, engine generator sets, small turbines, and fuel cell power systems. The database is meant to encourage appropriate distributed generation and combined heat and power applications that provide real benefits to system owners.

At the core of the project lie the development of four final performance protocols, the collection of performance data for a set of sites, and the reporting of the performance data and related information. The protocols are:

- The Laboratory Protocol
- The Field Protocol
- The Long-Term Monitoring Protocol
- The Case Study Protocol

Project Objectives

The project objectives are to:

- Receive user feedback on the interim performance protocols and then finalize the protocols during 2006.
- Operate the searchable National Database, so it is continually available on the www.dgdata.org website during the next three years, with future operation anticipated beyond the three-year horizon.

- Increase the number of distributed generation and combined heat and power systems reported in the database from approximately 30 to more than 200 within three years.

Project Outcomes

The project has met the three objectives and the specific deliverables described in the contract. The number of systems reported is for the two websites that have resulted from this collaborative project. Specifically, the final version (Version 1.0) of the protocols as well as the information on more than 200 distributed generation and combined heat and power systems are reported in publicly searchable databases on a national portal website and an associated website. The original vision for the project focused on a national portal and website. As the project progressed, the value of including and collaborating with a state level database became evident.

Conclusions

This project, through a highly collaborative effort with industry, government, non-government organizations, and researchers, has met the overall project goals by producing workable and concise performance protocols, and by making performance records publicly available. The data now available are a rich resource providing the basis for informed market decisions regarding the use of distributed generation and combined heat and power systems. It will enable a higher rate of successful installations. Collaboration with the New York State Energy Research and Development Authority has resulted in substantial data being made available beyond the original goal of this project, including a large amount of daily and hourly reported data.

Recommendations

The following are the recommendations of the project team:

- The Energy Commission should consider and, as appropriate, require the use of the national protocols in future projects involving distributed generation and combined heat and power systems where there is a public interest in measuring and reporting performance. Also, as appropriate, the Energy Commission should consider requiring the reporting of the data to the national database site and other sites.
- The plan for ongoing management and support of the national portal and database is not known beyond November 2009. Potential options for ongoing management and support include the Association of State Energy Research and Technology Transfer Institutions, the U.S. Department of Energy's Clean Energy Centers, and New York State Energy Research and the Development Authority on behalf of the Association of State Energy Research and Technology Transfer Institutions. The Energy Commission should continue to be engaged to help assure that a distributed generation and combined heat and power portal exists to support California and other users. It should be noted that New York State Energy Research and Development Authority has indicated that its successful programs, including its website, will continue. While this is valuable and desirable for California users, relying exclusively on the New York State Energy Research and Development Authority site would

eliminate the possibility of reporting California sites and of having a direct influence on future developments of the database.

- An alternate path for the Energy Commission in regards to using the protocols and reporting data would be to enter into a collaboration with New York State Energy Research and Development Authority. Data capture and reporting could be provided on a jointly funded site based on New York State Energy Research and Development Authority's website design.
- Should in the course of its ongoing research efforts the Energy Commission discover a need to modify any of the four protocols, the Energy Commission should consider undertaking the effort with the Association of State Energy Research and Technology Transfer Institutions and the U.S. Department of Energy.

Benefits to California

The benefits that California has received include two websites that provide ready access to performance protocols and to performance data on a large and growing number of distributed generation and combined heat and power units. These units are located in a wide variety of applications and have a diverse set of prime movers. California users will continue to benefit by having a standardized protocol for testing their systems during development and operation. Users can take advantage of this performance data from real project experience to guide design, development, and investment decisions.

1.0 Introduction

1.1. Project Goal

The main goal of this project is to increase the adoption of distributed generation/combined heat and power (DG/CHP) units by providing a basis for inter- and intra-technology comparisons. The expanded statement of this goal, which is included in the agreement with the California Energy Commission was:

> "The goal of this Agreement is to increase the adoption of DG/CHP systems by making reports on the operation of DG/CHP systems in multiple applications across the United States readily available. This goal includes increasing the number of sites from California and elsewhere in the United States that are reported on the searchable National Database in order to allow database users to see the performance of various DG/CHP systems in specific applications similar to those of the users of the database."

DG/CHP systems can provide higher energy efficiencies, lower energy costs, and lower overall operational cost than by generating power and heat separately. For these advantages of DG/CHP to be achieved, however, potential system owners, developers, engineers, and manufacturers must make informed decisions as to what technologies are best suited to their particular situations. Having reliable and consistent data for comparing DG/CHP technologies provides a basis for making informed choices as to when to adopt and when to avoid DG/CHP technologies.

1.2. Background and Overview

Distributed generation (DG) technologies are emerging as a viable supplement to centralized power production. With their ability to deliver higher efficiency with combined heat and power, they are anticipated to be an important part of California's and the nation's strategy to improve energy efficiency, and global economic competitiveness, and reduce environmental impacts, including global climate change. Independent evaluations of DG technologies are required to assess performance of systems and, ultimately, the applicability and efficacy of a specific technology at any given site. A current barrier to the acceptance of DG technologies is the lack of credible and uniform information regarding system performance. Therefore, as new DG technologies are developed and introduced to the marketplace, uniform and repeatable methods of evaluating the performance of a DG system are needed. This project and its associated protocols and database were developed to meet that need.

The protocols address the performance of microturbine generators, reciprocating engine generator sets (including Stirling cycle engines), small turbines, and fuel cell power systems (FCPS). The protocols apply to all of the generators listed above. The protocols are applicable to systems with and without CHP. Application of the protocols will provide uniform data of known quality that is obtained in a consistent manner for all systems evaluated. Therefore, the protocols will allow for comparisons of the performance of different systems, facilitating purchase and applicability decisions. There are parallel protocols as follows:

- The Gas Technology Institute and the Program Steering Committee developed the Laboratory Protocol to provide data on performance within a controlled laboratory setting.
- The Field Protocol provides detailed data for a short-term period on the electrical, thermal (if applicable), emissions, and operational performance of commercial DG systems in a field setting. The Southern Research Institute developed the field protocol.
- The Long-Term Monitoring Protocol is used for continuous testing at commercial sites for a limited set of parameters. The Connected Energy Corporation developed this protocol.
- The Case Study Protocol uses data collected using the Long-Term Monitoring Protocol as well as additional financial and qualitative information to provide an assessment of a commercial application. The University of Illinois-Chicago Energy Resources Center developed the case study protocol.

The performance results of DG systems tested and/or monitored with the protocols are housed in a free searchable database at www.dgdata.org managed by the National Renewable Energy Laboratory (NREL). In addition, data from New York sites using the Long-Term Monitoring Protocol are available at a related website at http://chp.nyserda.org.

The protocols are intended for use by those evaluating new technologies (research organizations, technology demonstration programs, testing organizations), those purchasing DG equipment (facility operators, end users), and manufacturers. They are intended solely to provide consistent, credible performance data. They are not intended to be used for certification, regulatory compliance, or equipment acceptance testing.

The Gas Technology Institute and Underwriters Laboratory have initiated an effort through Underwriters Laboratory's Standards Process to offer a certification service that allows testing at any qualified laboratory. Underwriters Laboratory is adopting the laboratory performance protocol as part of its certification development process.

1.3. Project Objectives

The project objectives were to:

- Receive user feedback on the interim performance protocols and then finalize the protocols during 2006.
- Operate the searchable National Database so it is continually available on the www.dgdata.org website during the next three years, with future operation anticipated beyond the three-year horizon.
- Increase the number of DG/CHP systems reported on the database from approximately 30 to more than 200 within three years.

2.0 Project Approach

2.1. Overview

The Final Performance Testing and Reporting Protocols were initially developed as interim protocols as part of the Collaborative National Program for the Development and Performance Testing of Distributed Power Technologies with Emphasis on Combined Heat and Power Applications, co-sponsored by the U.S. Department of Energy (U.S. DOE) and members of the Association of State Energy Research and Technology Transfer Institutions (ASERTTI). ASERTTI sponsoring members were the California Energy Commission, the Concurrent Technologies Corporation, the Energy Center of Wisconsin, the Montana State University-Billings, the National Energy Technology Laboratory, the National Renewable Energy Laboratory, the New York State Energy Research and Development Authority (NYSERDA), the Sacramento Municipal Utility District and the University of Illinois-Chicago. Other sponsors included the Illinois Department of Commerce and Economic Opportunity, the U.S. Department of Defense Fuel Cell Test and Evaluation Center and the U.S. Environmental Protection Agency Office of Research and Development. The program for development and performance testing of distributed power technologies is managed by ASERTTI.

The development of protocols was directed by several guiding principles specified by the ASERTTI Steering Committee:

- The development of protocols uses a stakeholder driven process.
- The resulting protocols use existing standards and protocols wherever possible.
- The protocols are cost-effective and user-friendly, and provide credible, quality data without excessive implementation costs.
- The final protocols will be validated prior to final publishing by using them and revising them, based on the validation test results.

The protocols were developed based on input and guidance provided by two stakeholder committees, the ASERTTI Stakeholder Advisory Committee and the U.S. Environmental Protection Agency (U.S. EPA) Environmental Technology Verification (ETV) Program's Advanced Energy Stakeholder Group, managed by the Southern Research Institute. The original Stakeholder Advisory Committee consisted of 36 stakeholders representing manufacturers, end-users, research agencies, regulators, and demonstrators. Additional Stakeholder Advisory Committee members were added in 2007 from stakeholders in the fuel cell industry.

The ASERTTI Steering Committee directed the project and provided a review and an approval of the interim Field Protocol dated October 27, 2004. The Southern Research Institute developed the protocol.

The ASERTTI Steering Committee is responsible for the final laboratory protocol based on the interim laboratory protocol developed by the Gas Technology Institute and a draft Fuel Cell Protocol developed by the Concurrent Technologies Corporation. The interim laboratory

protocol developed by the Gas Technology Institute and the field protocol developed by Southern Research Institute were developed in parallel and did not include fuel cell powered systems. Sections of the laboratory protocol were derived from the Southern Research Institute work for the field protocol.

The changes made in moving from the interim laboratory protocol to the final protocol were made in order to include fuel cell technologies and to make other adjustments based on experience and feedback in using the interim protocol.

The protocol development process consisted of several steps following the ASERTTI/U.S. DOE program's guiding principles. First, a list of performance parameters for which laboratory and field testing protocols should be written was completed. The parameters selected provide performance data for electrical generation, electrical efficiency, thermal efficiency, atmospheric emissions, acoustic emissions, and operational performance.

The laboratory, field, long-term monitoring and case study protocols development was based on existing standards, protocols, and the experience of the committees. Existing standards and protocols potentially applicable to DG systems were reviewed and evaluated. The existing standards and protocols form the basis for instrument specifications, acceptable test methods, quality acquisition/quality control procedures, calculations, and other requirements of this protocol. The laboratory protocol allows for the controlled evaluation of the effects of several parameters on performance of a DG/CHP system that cannot be reasonably verified in field testing. Laboratory testing also allows measurements under conditions that cannot be practically controlled in a field setting, such as ambient conditions, response to upsets, and grid-isolated (standalone) operation for determining transient response characteristics.

Reasonable compromises were sought to provide a balance between the requirement for credible, high-quality data, and requirements that these protocols be usable and affordable, so that they can be widely and consistently implemented and reported.

Figure 1 shows the program management structure and committees that were involved in the protocol development. Table 1 lists the Stakeholder Advisory Committee members.

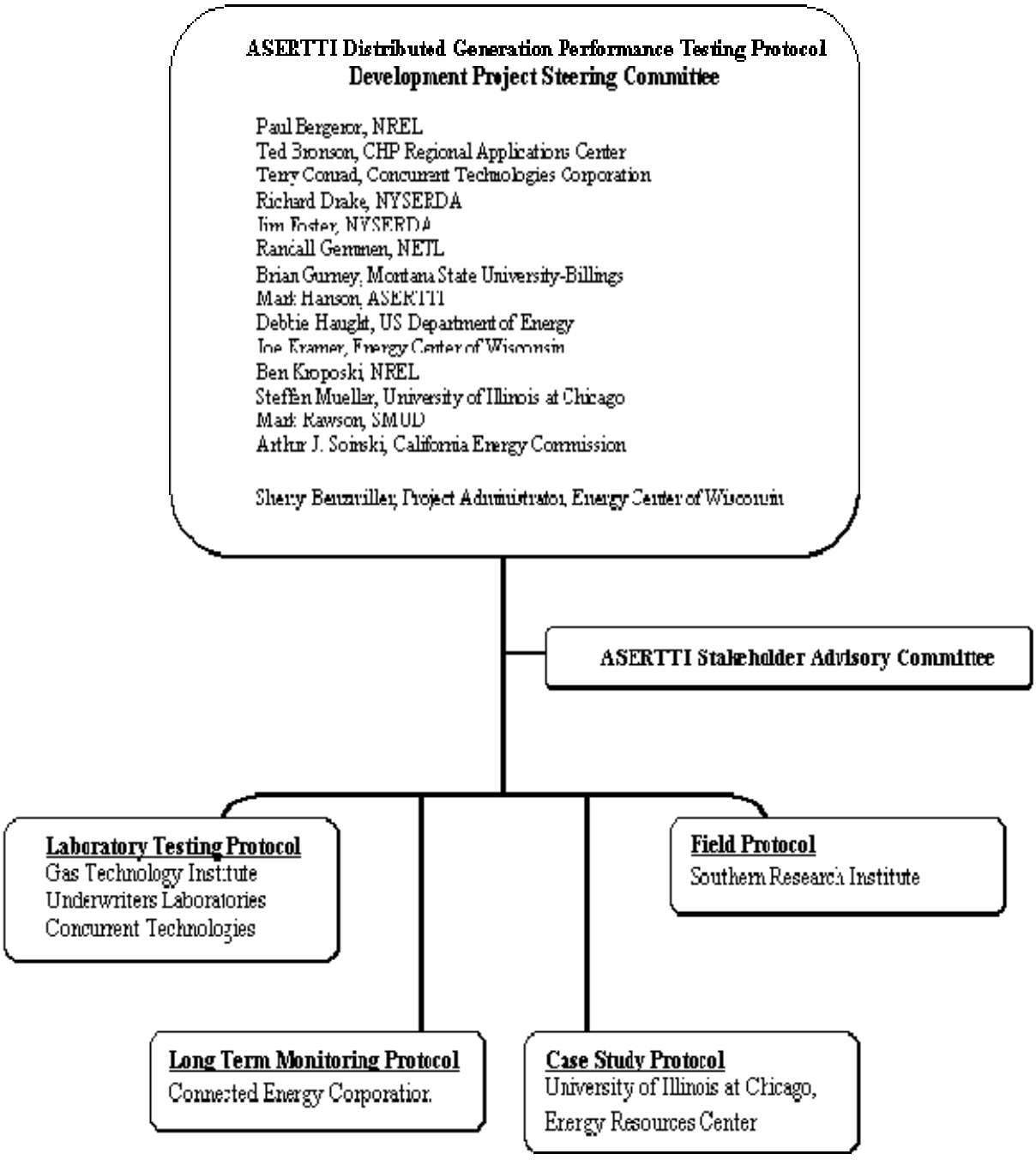

Figure 1. Program management structure and committees

Source: Energy Center of Wisconsin

Table 1. ASERTTI Stakeholder Advisory Committee

Representative	Company
Paul Abraham	Distributed Energy Strategies
Richard Adamson	Southern Research Institute
Mirko Antloga	Case Western Reserve University
Peter Armstrong	DTE Energy Technologies
Mike Batham	Sacramento Metropolitan Utilities District
Gary Blake	Delphi
Tim Callahan	Southwest Research Institute
Steve Carlson	CDH Energy
Matt Cinadr	New York State Public Service Commission
John Collins	American Society of Healthcare Engineering
John Cuttica	University of Illinois Chicago
Bob DeVault	ORNL
Dave Dewis	Elliot Energy Systems
Tom Easterday	Cummins Power Generation
Neal Elliot	ACEEE
Gearold Foley	Integrated CHP Systems Corp.
Thomas Frankiewicz	US EPA
John Gartner	Plug Power
Steve Gillette	Capstone Microturbine Solutions
Steve Greenberg	RealEnergy
Richard Hack	University of California - Irvine
Stephanie Hamilton	Southern California Edison
Tim Hansen	Southern Research Institute
Herbert Healy	UTC Power
Stephen Heinzelman	Connected Energy Corp
Joseph Heinzmann	Fuel Cell Energy (FCE)
Hugh Henderson	CDH Energy
Jeff Hinson	Clemson University
Dan Hoppe	Enercon Engineering Services
Dave Keefer	Southern California Edison
Bob Lindsey	Caterpillar
John McClain	Solar Turbines, Inc
Vince McDonell	University of California - Irvine
Dave Nichols	American Electric Power
Mickey Oros	Altergy Systems
Bob Pence	Underwriters Laboratories
Dan Rastler	EPRI
Bob Richards	Southern Research Institute
Greg Rouse	Gas Technology Institute
Dave Schnaars	Solar Turbines, Inc
Richard Shaw	Fuel Cell Energy
Richard Sweetser	Exergy Partners Corporation

Representative	Company
Larry Tangel	Enercon Engineering
Harry Terhorst	Hamilton Sundstrand Corporation
David Thimsen	EPRI
Ed Torrero	National Rural Electrical Cooperative Association
Jim Watts	Ingersoll Rand
Bob Wayland	US EPA
Robert Wichert	US Fuel Cell
Thomas Yeh	Connected Energy

Source: Energy Center of Wisconsin.

The project identified the following tasks to accomplish the objectives described in Section 3:

- Task 1: Administration
- Task 2: Project Management and Coordination
- Task 3: Fuel Cell System Performance and Testing Protocols
- Task 4: Final Performance Testing and Reporting Protocols
- Task 5: Searchable National Database Management

3.0 Project Outcomes

The project accomplished the objectives identified in the introduction. The first objective was to receive user feedback on the interim performance protocols and then finalize the protocols during 2006.

The project prepared the four protocols in final form, which is called Version 1.0. The Version 1.0 terminology acknowledges that as technology and national standards that are referenced develop, there may be a future need to modify these protocols. The California Air Resources Board test procedures are among the standards and protocols referenced in the Laboratory Protocol. These protocols were posted in 2008, after final Steering Committee and Stakeholder Advisory Committee review, on the national website that is operated by NREL. The website address is www.dgdata.org. The Steering Committee envisioned the website as a portal for system owners, developers, manufacturers, the research and development (R&D) community, and the public interested in DG/CHP. Hence the website includes links to other related organizations and efforts in the DG/CHP arena.

The final Version 1.0 protocols apply to five types of FCPS used at commercial sites. FCPS are electrochemical systems that convert the chemical energy of a reaction directly into electrical energy, water, and heat. The electrochemical reaction may use phosphoric acid, polymer electrolyte membrane, solid oxide, molten carbonate, or alkaline. Per the guidance of the new Steering Committee members added as part of expanding the protocols to include fuel cells, the test conditions were also expanded to include both higher and lower ambient temperatures. To help keep the expense of using the protocols reasonable, the testing conditions were modified to include required tests as well as a broader set of optional test conditions.

User feedback was used in developing the final protocols. One form of feedback was provided by way of the various project participants, including comments of the Stakeholder Advisory Committee. It was particularly useful as the fuel cell DG/CHP systems were being added. Comments were provided by a number of fuel cell manufacturers and users. A number of field validations were completed using both the Field Protocol and the Laboratory Protocol. The field validations were conducted by the Southern Research Institute. CDH Energy provided further hands on experience as it captured data from numerous New York DG/CHP sites for reporting on the NYSERDA website http://chp.nyserda.org.

The second objective was to operate the searchable National Database so it is continually available on the www.dgdata.org website through 2009, with future operation anticipated beyond the three-year horizon.

The project database and overall DG/CHP portal is www.dgdata.org. This site is operational and managed by NREL. As part of the database, this site has some key supporting documents including a validation report for the Laboratory Protocol and some validation reports for the Field Protocol. An additional field validation report for a fuel cell site is imminent, but not yet posted as of the date of this report. The www.dgdata.org website has been continuously available since 2006and is currently still in operation.

The NYSERDA website http://chp.nyserda.org provides next day hourly and daily reporting of power generation for a large set of DG/CHP sites in New York. This is a substantial expansion in the detail of the data provided and other DG/CHP site information to website users. The original project goal was to provide annual summary performance data, which is provided on www.dgdata.org.

The third objective was to increase the number of DG/CHP systems reported on the database from approximately 30 to more than 200 by 2009.

The progress of reporting DG/CHP systems on the national site has been slower than anticipated. To date only 24 sites are reporting. The related NYSERDA site however, with its expanded functionality, has been very successful. As of November 17, 2009, the NYSERDA site provides daily monitored data for 131 power units. The total population of power units being reported is 290 located at 111 facilities. There is considerable overlap between the 24 systems on the national website and the 290 power units on the NYSERDA website. This overlap will continue as more summary data is provided from the NYSERDA site to populate the www.dgdata.org site.

A disappointment in the project is the dearth of California DG/CHP projects reporting their data. Discussions with project managers and others suggest that the difficulty that the Energy Commission faces in projects, which it sponsors, is in capturing and reporting data from its sites. One of the barriers is that DG/CHP installations, to which the Energy Commission commits R&D funds, tend to be pre-commercial and hence often not suitable for the evaluation of commercial units in field application. California's Self-Generation Incentive Program does not require data capture and reporting at the level of the long-term monitoring protocol.

4.0 Conclusions and Recommendations

4.1. Conclusions

The project is meeting the overall project goal "to increase the adoption of DG/CHP systems by making reports on the operation of DG/CHP systems in multiple applications across the United States readily available." The project also met the three objectives as well as the specific deliverables described in the contract. This project is the culmination of a long collaborative effort that initially began as a discussion among the Energy Commission, other ASERTTI members, and U.S. DOE in 1999 over areas of mutual interest.

Establishing a causal link between this work and the number of DG/CHP systems being installed and this project was not attempted and was beyond the scope of work. The performance protocols and the site data are available at the national portal website and the NYSERDA website. The vast majority of site and systems data is available in an expanded format on the chp.nyserda.org site linked to the main project website at www.dgdata.org. Specifically, the expanded format provides daily and hourly data, and provides that data on a next day basis. This exceeds the original goal of the project which was to provide annual summary data on generation units.

4.2. Recommendations

The Public Interest Energy Research (PIER) Program has been an essential contributor to this collaborative program with other ASERTTI members and the U.S. DOE. While the U.S. DOE contributed the majority of funds for the 2002 to 2006 project that preceded this effort, U.S. DOE contributed only in-kind support in the form of some staff time for this project covering the years 2006 to 2009. In this context, the PIER and NYSERDA funding were critical to the project. While PIER played this important role, the Energy Commission has struggled to date with being able to capture data from the Energy Commission supported DG/CHP installations in California. Thus, while the protocols and databases are useful and are likely being used in evaluating performance of California systems receiving funding from the Energy Commission as well as other DG/CHP decisions not linked to the Energy Commission, data is not being captured for reporting purposes on the project database. It should also be noted that California manufacturers and system developers of DG/CHP systems have the protocols available for their use.

The following are the recommendations of the project team specific to the Energy Commission as well as more generally to promote the optimal use of the protocols and databases in support of the development of DG/CHP systems in California and beyond.

- The Energy Commission, the California electric utilities, the administrators of the Self-Generation Incentive Program, and the California Air Resources Board should continue to require the use of the national protocols in future projects involving DG/CHP systems where there is a public interest in measuring and reporting performance. Also, as appropriate, the Energy Commission should consider requiring the reporting of the data to the national database site and other sites.

- The plan for ongoing management and support of the national portal and database is not known beyond December 2009. Potential options for ongoing management and support include ASERTTI, U.S. DOE's Clean Energy Centers, and NYSERDA on behalf of ASERTTI. The Energy Commission should continue to be engaged to help assure that a DG/CHP portal exists to support California and other users. It should be noted that NYSERDA has indicated that its successful programs will continue, including its website. While this is valuable and desirable for California users, relying exclusively on the NYSERDA site would eliminate the possibility of reporting California sites and having a direct influence on future developments of the database. Energy Commission and other ASERTTI members' collaboration with the U.S. DOE Clean Energy Centers would appear to be the most logical approach to establish long term management of a national website. It is recommended that the Energy Commission and potentially other ASERTTI members co-fund this effort with the U.S. DOE to manage the national website. Within such an arrangement, it would be desirable to have sites reporting from each of the Clean Energy Centers. Annual summaries, possibly updating the case study protocol information would be useful. If the arrangement with the Clean Energy Centers cannot be established, another approach would be to continue the website functions at the ASERTTI website. This would require some ongoing management under ASERTTI auspices.
- An alternate path for the Energy Commission in regards to using the protocols and reporting data would be to enter into collaboration with NYSERDA by which data capture and reporting could be provided on a jointly funded site based on NYSERDA's site design.
- Should, in the course of its ongoing research efforts, the Energy Commission discover a need to modify any of the four protocols, the Energy Commission should consider undertaking the effort (with ASERTTI and U.S. DOE as appropriate) to make those modifications so they are available.

4.3. Benefits to California

The benefits that California has already received are that the two websites provide ready access to the performance protocols and to performance data on a large and growing number of DG/CHP units located in a wide variety of applications with a diverse set of prime movers. Thus, California users can take advantage of this information drawing on real project experience and system performance to guide design, development and investment decisions. The goal is to make the best system choices possible where the systems are justified, and to avoid investments where real world experience indicates that the projects will not be economical. California DG/CHP manufacturers and developers will benefit by having a standardized protocol for testing their systems during development that will provide performance information that is directly comparable to other installations and technologies.

As a result of this project, California has collaborated in the development of standardized cross-technology DG/CHP performance protocols to provide information needed for successful deployment of these systems in the state. While the data does not yet include information on

California installations, the means to track performance of new systems, and a rich data set of experience from existing systems provide a solid foundation for promotion of DG/CHP systems in California consistent with the *2007 Integrated Energy Policy Report*.

Glossary

Specific terms and acronyms used throughout this report are defined as follows:

Acronym	Definition
ASERTTI	Association of State Energy Research and Technology Transfer Institutions
CHP	Combined heat and power
DG	Distributed generation
ETV	Environmental Technology Verification
FCPS	Fuel cell power systems
NREL	National Renewable Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
PIER	Public Interest Energy Research
RD&D	Research, development, and demonstration
R&D	Research and development
U.S. DOE	United States Department of Energy
U.S. EPA	United States Environmental Protection Agency